Permabond Training

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Preface

• Read and follow the health & safety instructions on the adhesive packaging and material safety data sheet. Always use the appropriate personal protection equipment. Good practice would be to wear eye protection and gloves when handling any adhesive. Understand the pot life (usable time) of the material as well as the cure time.

• Ensure that the material is at room temperature. If the material has been stored in a cold place (i.e. a warehouse in winter), it can be too thick to mix and dispense easily and correctly. Let it come to ambient temperature before use. Some materials will become too thin (too low a viscosity) to mix and dispense correctly if stored in a very warm place. Again, bring to room temperature before use. On the other hand, some materials which are quite thick (highly viscous) at room temperature, and therefore difficult to dispense, can be gently warmed prior to use. If in any doubt, please consult Permabond Technical Support.

• Ensure that all parts being bonded are clean.

Permabond Training

1. Anaerobic Ahesives and Sealants

What is an anaerobic, how do they work, where are they used?

- Anaerobic Adhesives and Sealants are single component products used for threadlocking, thread sealing, retaining and gasketing.
- They polymerize when oxygen is excluded (gap <0.5mm) and metal ions are present.

Threadlocking nuts and bolts

Thread sealing pipes

Retaining bearings, shafts etc.

Gasketing flanges, gearboxes, etc.

Hands On

Anaerobic Characteristic Demonstration

You will need:

- Sample of anaerobic e.g. MM115
- Plastic test pieces
- Metal test pieces
- Nitrile gloves

1. Dispense Permabond MM115 onto plastic part. See that it remains liquid.

The adhesive does not cure in the bottle or on the plastic because there is no metal present and it is in the presence of oxygen.

Note: *the airspace in the bottle helps keep the product stable*

2. Put another plastic test piece on the top and close the joint.

The adhesive still doesn't cure, although the oxygen has gone there is no metal present to trigger the cure.

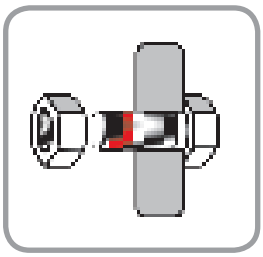
3. Now do the same on the metal test piece, dispense a bead of adhesive onto the surface.

Nothing will happen because the joint is not closed and the oxygen is still preventing the cure.

4. Close the joint now by firmly holding a second metal test piece onto the first. Clamp with bulldog clips.

Refer back to this after handling strength has been achieved. The adhesive should cure.

1. Anaerobics



A. *Threadlocking*

Threadlocking - Principles & Importance

Threadlocking is the bonding and sealing of nuts and bolts, to prevent vibration loosening, seal and prevent corrosion.

Why bother?

If nuts and bolts come loose, working machinery parts can come loose, damaging equipment, causing injury or even loss of life. Other adverse effects include production line down time, re-engineering damaged parts, damage to reputation for unreliability.

Other Methods Include:

- Nyloc nuts & bolts
- Lock washers

Limitations with other methods:

- Offer no seal
- Increase component weight
- Can't be re-used

Other chemical options include preapplied threadlockers and "stick" type threadlockers. Due to incomplete coverage these methods fail to prevent corrosion or offer a 100% seal.

Threadlocking - Benefits

1. No vibration loosening = no failures, damage, loss of repuration
2. No leakage around bolt holes
3. Prevents corrosion
4. Good resistance to chemicals and high temperatures
5. Low viscosity grade can be applied post assembly
6. Oil tolerant grade (HM129) can be used on particularly soiled parts

Permabond Training

Case Studies

Show the following case studies:

■ **Passenger Boarding Bridges** ■ **Oil Refinery** ■ **Treadmill** ■ **Rigging Screws**
■ **Communications Device** ■ **Compressor End Cap** ■ **Butterfly Valve** ■ **Raised Access Flooring**

Show Anaerobic Chemical Compatibility Chart
Show TST Threadlockers

Threadlocking - Product Selection

Threadlockers are available in a range of different strengths, viscosities and cure speeds to suit the application requirements:

Viscosity

- Very low viscosity - for post application
- Low viscosity - for fine threads and small diameters
- Medium viscosity - for larger threads and diameters
- High viscosity - for large diameter parts - will not drip off.

Strength

- Low strength - for easy dissembly
- Medium strength - for future dissembly
- High strength - for permanent threadlocking

Cure Speeds

- Slow cure - for accurate alignment
- Fast cure - ideal for inactive metal surfaces or where a quick handling time is required. See chart below.
- High temperature resistant grades are available for up to 445 °F (230 °C)
- Many grades are approved for contact with drinking water (NSF/ANSI 61).

Super Active (Very fast cure)	Active (Fast cure)	Inactive (Slow cure)	Passive (Activator required)
Brass	Steel	Aluminum	Anodized aluminum	Passivated metals	Ceramics	Plastics
Copper	Nickel	Zinc	Cadmium finishes	Stainless steel	Glass	Painted finishes
Magnesium	Iron		Chrome finishes	Titanium	Lacquered finishes	

Permabond Training

Hands On

Diameter Effect Demonstration

Show M6 has double the diameter of M3, but needs 6 x the force to undo it.

You will need:

- Sample MM115 (blue, medium strength)
- M3, M6, M8 and M12 nuts and bolts from kit and the adjustable torque wrench

Prepare the day before using Permabond MM115 to threadlock the M3, M6, M8 and M12 nuts and bolts.

Show how easy it is to unscrew the MM115 bonded M6 nut and bolt with a torque wrench. Now try the same with the M8 and M12. Measure using the torque wrench.

Hands On

Blind Hole Demonstration

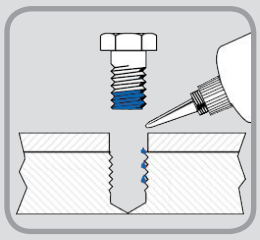
You will need:

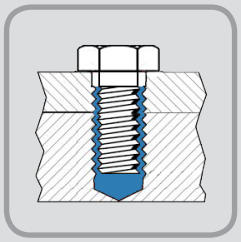
- Sample MM115 (blue, medium strength)
- M8 Nuts and bolts
- IPA wipes
- Blind hole demo kit

1. Open the bottle, cut the tip of the nozzle to the appropriate size for the application. Explain that the tip must not touch metal parts as it can contaminate the adhesive.

2. Dispense a bead of adhesive across the contact length of the thread when working with through holes.

3. When working with blind holes apply several drops down the threads to the bottom of the hole. Demonstrate this with the clear plastic demo hole kit*. Show the difference that applying to the bolt can cause an air lock at the bottom of the hole and inadequate coverage.





4. Screw nuts and bolts together.

5. Replace the cap to the bottle to avoid contaminating the remaining liquid adhesive.

6. Any excess adhesive can be cleaned away with the wipe.

* This is for demonstration only. Threadlockers are not for use on plastic.

Permabond Training

Hands On

Blind Hole Demonstration

You will need:

- Sample HL126 (green, high strength, low viscosity)
- Blind hole demo kit
- IPA wipes

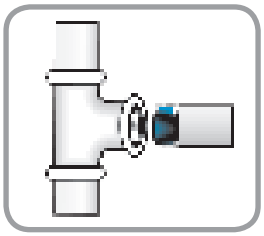
1. Open the bottle, cut the tip of the nozzle to the appropriate size for the application.
2. Thread the fastener into the blind hole in the acrylic block.
3. Dispense several drops of Permabond HL126 into the side of the fastener. Show how the HL126 “wicks” into the assembled area quite easily.
4. Replace the cap to the bottle to avoid contaminating the remaining liquid adhesive.
5. Remove the fastener from the block and clean any adhesive with the wipe from both the fastener and the blind hole.

NOTE - Before reapplying anaerobic adhesive it is very important to remove traces of previously cured product since this acts as a barrier to the cure - like a coating. To do this use a wire brush, wire wool or carborundum paper; soaking in methylene chloride may help remove stubborn residue. Be sure to degrease.

Permabond Training

1. Anaerobics

B. Thread sealing



Thread sealing - Principles & Importance

Thread sealing is the sealing of threaded pipe joints primarily to prevent leakage.

Why bother?

- Leakage will result in spoiled fixtures and fittings
- Waste of expensive fluids
- Breakdown of equipment and machinery
- Down time of manufacturing equipment
- Injury to people
- Contamination & mess

Other Methods Include:

- PTFE Tape
- Solvent based pipe dope

Limitations with other methods: PTFE tape is difficult to put on in the right direction, shreds easily, blocks valves, loosens easier by vibration, does not fill all thread roots, easily over tightened, easily cross threaded when tightening joints.

Solvent based systems get brittle over time.

Hands On

Anti-Clog Demonstration

You will need:

- **PTFE tape**
- **Pipe joints / connectors**
- **Vial containing shredded PTFE in hydraulic oil**
- **Vial containing Permabond in hydraulic oil**

Assemble the joint using the tape, then undo it again to show the stredding of the tape. Show the vials of shredded bits of tape that can go into the system and block valves.

Uncured Permabond threadsealant is benign and washes away easily without causing blockage.

Thread sealing - Benefits

- Resistance to vibration loosening
- Rust prevention
- Easy to apply
- Allows for post assembly adjustment to accurately position pipes and fittings
- Easy to wipe off (in uncured state)
- No odor
- Chemical and heat resistant
- Various grades for strength and gap filling needs
- No loose particles to clog valves
- Will not shred, creep, or relax over time
- Lubricates for easier assembly
- Typically seals to the burst pressure of the pipe when fully cured
- Grades suitable for potable water, gas, air, hydraulic systems & oxygen available

Permabond Training

Anaerobics

Threadsealing - Product Selection

Threadsealants are available in a range of different strengths, viscosities, and cure speeds to suit the application requirements:

Viscosity

- High viscosity - for large diameter parts - will not drip off.
- Very high viscosity - for very coarse threads

Strength

- Low strength - for easy disassembly.
- Medium strength - for future disassembly
- High strength - for resistance against harsh, searching chemicals such as refrigerant gases

Cure Speed

- Slow cure - for accurate alignment
- Fast cure - ideal for inactive metal surfaces or where a quick handling time is required

Some grades are approved for contact with drinking water. Some also have gas approval.

Case Studies

Show the following case studies:

- ***LH050 Compressor Package System***
- ***LH050 Bus Heater***
- ***LH050 PURE Meter Sealing***
- ***LH050 PURE Pump Booster***
- ***LH050 PURE Water Heater***
- ***LH150 Air compressors***
- ***LH150 Road patching Eq***
- ***MH052 Auto inflation Actuator***
- ***MH052 Golf Club Nitrogen Seal***
- ***MH052 Hot Water Tanks***
- ***MH052 Infant Resuscitator***
- ***MH052 Mine Shelter***
- ***MH052 Oxygen Regulator***

Incorrect Product Application

• Parallel to parallel pipe joints

Applying the adhesive to the female part pushes it into the pipe. It is impossible to tell if you have enough adhesive as no excess can be seen on the outside of the joint.

• Taper to parallel pipe joints

The adhesive has been applied to the area where least contact is made between the parts, resulting in a poor seal.

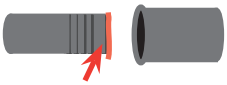
• Taper to parallel pipe joints

Again, it is impossible to see if enough adhesive has been used as there is no excess visible.

NOTE: Excess adhesive on the inside of a pipejoint can be easily flushed away when the pipework is purged before use.

Correct Product Application & Removal

• Parallel to parallel pipe joints (Fig A.)



(Fig A.)

Apply sealant to the leading 3 - 4 threads of the male component.

• Taper to parallel pipe joints (Fig B.)

(Fig B.)

Apply sealant several threads back from the leading edge of the male component to ensure maximum contact.

*** IN EACH CASE EXCESS SEALANT SHOULD BE VISIBLE AFTER TIGHTENING**

Pipe joints sealed with low-strength thread sealants can be dismantled using normal tools.

Heating parts with a hot air gun or blow torch will make parts easier to disassemble.

Before reapplying sealant, clean pipe joints with a wire brush.

Permabond® Engineering Adhesives

Permabond Training

Hands On

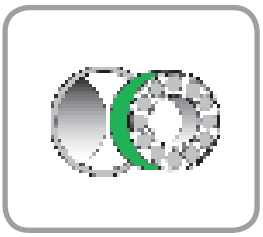
LH050 Instant Seal Demonstration

You will need:

- Threaded Pipe Lengths (threads cut)
- IPA wipes
- LH050 sample
- CO_2 cartridge & Holder
- Pressure Guage Assembly

1. Show the cut threads on the pipe length
2. Apply LH050 half way around the leading 3 - 4 threads of the male pipe length
3. Ensure valve is closed on the pressure gauge assembly and thread the pipe length into the assembly. Only hand tighten the assembly.
4. Insert the CO_2 cartridge into the holder (recheck valve to ensure it's closed)
5. Thread the cartridge into the pressure guage assembly
6. Open the valve and allow pressure to go up to 500 psi to demonstrate the instant seal capability of Permabond LH050
7. Release pressure off of the pressure gauge assembly and disconnect the pipe length from the assembly
8. Ensure that both male and female threads are throughly cleaned for the next demonstration

1. Anaerobics



C. *Retaining Compounds*

Retaining - Principles & Importance

Retaining is the high strength bonding and sealing of cylindrical metal parts such as collars to shafts, bearings to housings, keyways and splines. Typically with very high shear and tensile strengths.

Why bother?

Other methods such as interference fits, shrink fits etc require a great deal more engineering and much tighter tolerances. In addition, the metal surfaces can fret together, wear and corrode.

Problems encountered if bearings, gears or sprockets spin on a shaft can include the breakdown of equipment, which can be very costly for a manufacturer in terms of down time, lost revenue and repair costs. Initial proper assembly with a Permabond retaining compound will ensure that production lines keep running properly.

Other Methods Include:

- Shrink fits
- Interference fits
- Keys and keyways
- Splines
- Press fit
- Expansion fits

Problems with other methods:

- Extra machining to maintain tight tolerances correlates to higher component cost
- Corrosion in joint due to air gap
- Only 20% metal contact corresponds to poor stress distribution
- Metal fretting, corrosion and rust.
- Lower strength
- Creep
- Poor sealing ability

Permabond's high performance anaerobic formulations provide 100% surface-to-surface contact compared to only 20% of surface-to-surface contact that mechanical joining techniques provide. The resulting increase in surface area allows for a greater load carrying capacity equal to more than 5 times that of mechanical joining techniques. Additionally, these retaining compounds allow for relaxed machine tolerances, drastically reducing costs and increasing the life of the components. They eliminate the need for heated joining processes providing more efficient processing.

Anaerobics

Retaining Compound- Benefits

- Machining tolerances can be relaxed equating to lower cost
- Various grades for different sized fittings and gap filling needs
- 100% metal to metal contact for better stress distribution
- Protects against metal fretting & corrosion
- Vibration proof – will not loosen over time
- Single part – no mixing required, easy clean up
- Ability to bond dissimilar metals
- Fast assembly
- Parts can be re-used and are undamaged
- Easy to apply
- No design change – standard parts can be used
- Easy to wipe off (in uncured state)
- No odor
- Chemical and heat resistance

Retaining Compound - Product Selection

Retaining compounds are available in a range of viscosities and cure speeds to suit the application requirements.

- Wicking, Low, Medium and High Viscosities
- Thixotropic products are also available

Retaining compounds are generally all for high strength permanent bonding so both shear and torque strengths are high.

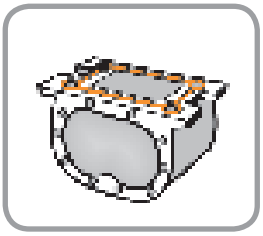
Standard products are suitable for use up to about 150°C, but there are Permabond products suitable for up to 230°C.

Assess the size of parts, fit of parts and how the adhesive is to be applied to determine the most suitable retaining adhesive for the application. Make sure to check the operating temperature range to decide whether a standard or high temperature product would be most appropriate. For inactive / passive surfaces choose a more reactive product and / or use the ASC10 Anaerobic Surface Conditioner.

Permabond Training

1. Anaerobics

D. Gasketing



Gasketing - Principles & Importance

Gasketing is the sealing of two faces. Permabond's liquid form-in-place gasketmakers seal two faces to prevent leakage.

Why bother?

Metal surfaces have tiny imperfections which will leak under pressure. Anaerobic gasket making adhesive will fill these microscopic holes and create 100% seal, and better stress distribution between components

Leakage will result in:

- Spoiled fixtures and fittings
- Waste of expensive fluids
- Breakdown of equipment and machinery
- Down time of manufacturing equipment
- Injury to people
- Contamination & mess
- Explosion risk (e.g. fuel / gas pipes)

Other Methods Include:

- Preformed gaskets such as rubber, cork, paper
- Silicone gasket makers

Case Studies

Show the following case studies:

- ***LH197 Sump Gasket***
- ***MH052 Auto inflation Actuator***
- ***MH052 Golf Club Nitrogen Seal***
- ***MH052 Hot Water Tanks***
- ***MH052 Infant Resuscitator***
- ***MH052 Mine Shelter***
- ***MH052 Oxygen Regulator***

Problems with Precut gaskets:

- They can relax and compress, requiring regular maintenance to tighten bolts or replace gaskets. This can lead to equipment downtime (best case scenario); damage is caused by leakage or even blockage caused by degradation of gasket (worst case scenario).
- They are very fragile to handle and are difficult to store. In addition, you must have the correct gasket shape for the part you are fitting. This results in a high level of stock inventory and storage.
- They degrade over time
- They do not create a complete seal

Problems with Silicone gasket makers:

- Can take a long time to cure
- Messy to use, apply and clean up
- Contain isocyanates which many workplaces will no longer allow
- Require a reasonably large gap to accomodate them
- Although they appear cheap by the cartridge, the fact you are using so much product means a higher cost per gasket than anaerobic form-in-place gasketmakers.

Permabond Training

Gasketing - Benefits of using liquid gasket maker

- 100% contact for better stress distribution
- No relaxation or shrinkage; no retorquing
- One adhesive replaces many pre-cut gaskets
- No disintegration so no leaks or blockages
- Vibration proof
- Will not get brittle
- Easy to dismantle with normal tools
- Chemical and heat resistance
- Reduced surface smoothness = less machining
- Non-shimming
- Prevent rust and corrosion
- One part
- Easy to apply
- Easy to wipe off (in uncured state)
- Fast
- No odor

Hands On

Form-in-place Gasket Seal Demonstration

You will need:

- Part with metal face and bolt holes which requires a gasket
- IPA wipes
- MH196 sample

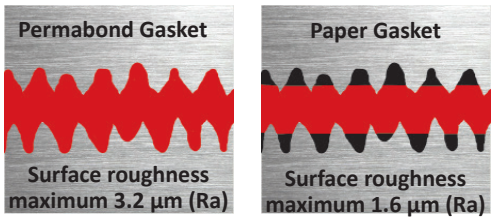
1. Wipe metals face clean to remove any contamination. Explain that contamination could result in lower strength and incomplete sealing.

2. Open the bottle, show how to cut the tip of the nozzle to the appropriate size for the application. Explain that the tip must not touch metal parts as it can contaminate the adhesive.

3. Apply the adhesive as a continuous bead, encircling the bolt holes to make a 100% seal.

Gasketing - Product Selection

Permabond offers several different gasket makers including general purpose, high temperature resistant and instant pressure seal. Permbond also manufactures a highly flexibilized gasket which is ideal for use on soft metals such as brass and aluminum.



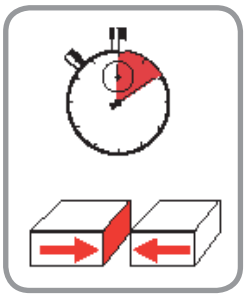
They all work on the same principle and have excellent resistance to fuel, oil and other chemicals.

Gasketing - Product Application

Permabond anaerobic gasketmakers can be applied directly from the bottle. Unique accordian packs are available for ease of use. They can also be applied via an automated dispense system to form intricate patterns (i.e. surrounding bolt holes) and by roller or silk screen.

Permabond® Engineering Adhesives

2. Cyanoacrylates



What is a cyanoacrylate, how do they work, where are they used?

- Single part - no mixing required
- Polymerization occurs when adhesive is between two parts (<0.5mm gap)
- React with minute traces of moisture
- Can be used on most substrates
- Very rapid cure
- Diverse uses; Ideal for high speed production lines requiring bonding of small components (i.e. disposable medical devices, lubrication strips on razors, small plastic parts, rubber bonding, o-rings)

Why bother?

Cyanoacrylate adhesives cure very quickly at room temperature, eliminating the need for costly ovens or curing equipment. Cyanoacrylate adhesives also overcome the limitations found in traditional methods of joining plastics to plastics and metals to metals. In addition, they are clearly the best choice for joining dissimilar substrates (i.e. metal to plastic; plastic to rubber), bonding acidic surfaces (i.e. wood, leather, paper or cork), and porous surfaces (i.e. pourous ceramic).

Other Methods Include:

- Mechanical Fasteners
- Ultrasonic Welding
- Solvent Welding
- Solvent Cement

Limitations of Mechanical Fasteners

- Create stresses in the substrate that could lead to distortion or cracking
- Require allowance for holes in the design
- Create appearances that can interfere with the styling of the end product
- Concentrate all the holding power at the fastener location causing the applied force to be carried by a small area of the plastic or rubber.

Limitations of Ultrasonic Welding

- Cannot be used on thermosets
- Cannot be used to join plastics/rubber to other substrates such as metal or glass
- Requires tighter design tolerances (small area to concentrate the ultrasonic energy is desirable)
- Limits the capability of joining different thermoplastics in the same assembly
- Requires a large investment in machinery

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Limitations of Solvent Welding

- Cannot be used to join plastics/rubber to other substrates such as metal or glass
- Cannot be used with thermoset plastics/rubber
- Has a tendency to cause stress cracking
- Requires pre-set and consistent time between the application of the solvent and mating of the parts

Limitations of Solvent Cement

- Have poor resistance to heat and solvents
- Emit fumes that may be toxic or flammable
- Require ventilation
- Require extensive drying time
- Require design to avoid trapped solvent which may lead to weakness
- Have poor gap filling capability
- Require a long time to achieve full strength

Benefits of using cyanoacrylates

- Fast setting (0 to 60 seconds)
- Single-part liquids
- Cure or polymerize at room temperature
- Rapid high strength development
- They bond to most rubber, plastic, & metal surfaces

Cyanoacrylate - Product Selection

Cyanoacrylate adhesives are available in a range of viscosities and cure speeds to suit the application requirements. Thixotropic products are also available.

- **Surface Insensitive** - overcomes the challenges posed when bonding acidic surfaces
- **Toughened** - Forms bonds with strong shear & tensile properties. Consider this type when the assembly is subject to vibration, impact, peel or flexing.
- **Non-blooming*, Low Odor** - these proprietary low odor formulations contain low vapor pressure monomers which result in a less volatile product. There is little odor during application and virtually no residue when cured.
- **High Temperature Resistant** - Permabond's 800 Series offer the highest temperature resistance available in ambient cure conditions. Permabond's 900 Series are formulated to offer increased temperature resistance with the use of a secondary heat cure process.

* **Chlorosis (frosting or blooming) -** caused by the liquid material vaporizing and reacting with the atmospheric moisture. The material cures and falls as a white, dusty marking on the surface. This phenomenon can be reduced by the following methods:

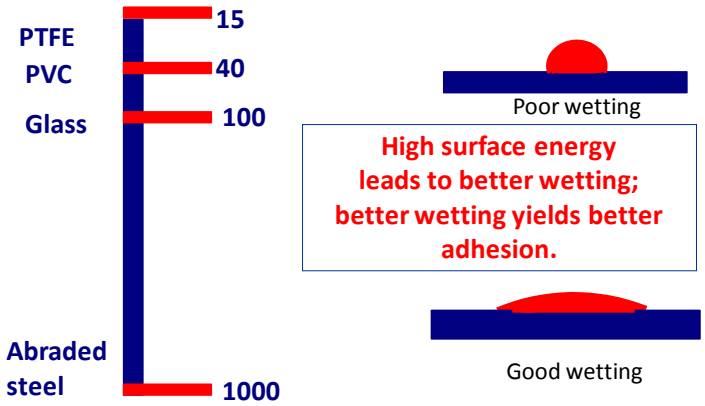
- Using less adhesive - Only excess liquid adhesive outside the bond line can cause frosting
- Increase cure speed - Cyanoacrylates can't cause chlorosis once they have cured to a solid state. This can be done by using a faster grade (Permabond 790 Series), using an accelerator (Permabond QFS16 or CSA NF)or by using less adhesive.
- Use a cyanoacrylate with a lower vapor pressure (Permabond 940 Series).

Factors Affecting Cyanoacrylate Performance

- Humidity - Low humidity = slower cure speed
- Viscosity/Gaps - Low viscosity for small gaps
- Substrates - PTFE (Teflon®*), Silicone, Polyethylene, Polypropylene are difficult to bond consider using Permabond Polyolefin Primer (POP) for surface preparation† on these substrates.
- Excess adhesive - Less is best

*Teflon is a registered trademarks of E.I. du Pont de Nemours and Company

†**Surface Preparation -** Most materials can be bonded without surface pre-treatment unless surfaces are grossly contaminated. To achieve maximum performance and repeatable results, it is advisable to ensure the bondable surface is clean and consistent. Increasing the surface energy can optimize the bond strength. Using Permabond Polyolefin Primer (POP) is one method of increasing the surface energy of the substrate.



Permabond Training

Hands On

Cure Mechanism Demonstration

You will need:

- Sample of cyanoacrylate (Permabond 102)
- Plastic test pieces
- Nitrile gloves

1. Dispense Permabond 102 onto plastic part and show that it remains liquid. *Why doesn't the adhesive cure in the bottle or on the plastic?*

Answer: *There are stabilizers in the cyanoacrylate which keep it liquid. The way to deactivate the stabilizers is to get them in contact with the moisture on the surfaces being bonded.*

2. Put another plastic test piece on the top and close the joint. Hold tightly shut for a few seconds.

The adhesive should cure (unless there is far too much adhesive present).

The adhesive stabilizers are deactivated by the presence of microscopic traces of moisture on the surface which causes the adhesive to cure.

A common mistake people make is when the adhesive doesn't appear to be curing, they add more adhesive, this exascerbates the problem.
Less = Best

Hands On

O-Ring Demonstration

You will need:

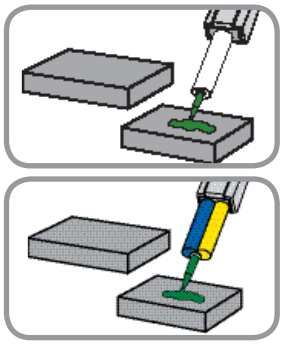
- Sample of cyanoacrylate (Permabond 105)
- Sample of primer (Permabond POP)
- Silicone cord stock
- Nitrile gloves

1. Cut the starting end of the silicone cord stock with a clean razor blade. Ensure the cut is clean and square. Do not touch the clean cut end.
2. Measure cord stock to appropriate length.
3. Cut the measured end of the silicone cord stock with a clean razor blade. Ensure the cut is clean and square to optimize bond area.
4. Apply one drop of Permabond 105 Instant Adhesive and mate the two ends of the silicone cord stock and wait 30 seconds.
5. Pull on the bonded O-ring and it should come apart.
6. Repeat the process but spray both ends of the cord with Permabond Polyolefin Primer (POP). The O-ring should not pull apart or you should get substrate failure.

Permabond Training

3. Epoxies

What is an epoxy, how do they work, where are they used?



- Single part epoxies already contain the hardener inside the resin; this is activated by heat, upon reaching the correct curing temperature, the adhesive will harden to a very high strength material.
- Two part epoxies have separate resin and hardener which require thorough mixing in the correct ratio before curing at room temperature. Applying heat will make the adhesive cure faster.
- Epoxies will cure regardless of the surface you are bonding to or the gap and need not have a closed joint to cure.

Why bother?

They are ideal for structural bonding, potting and encapsulation of electronic components, bonding composites, and bonding tungsten carbide tools & machinery. They are perfect for any heavy wear-and-tear applications and have excellent durability for use in outdoor environments. Epoxies are often used to replace welding and brazing and can significantly reduce assembly production costs.

Other Methods Include:

- Mechanical Fasteners
- Welding
- Brazing
- Other Thermal joining methods

Limitations of Mechanical Fasteners

- Create stress concentration points
- Are visible additions to the joint or seam
- Limited load distribution points

Limitations of Welding / Brazing / Other Thermal Joining Limitations

- Distort components
- Require secondary operations (painting, grinding) to achieve an aesthetically pleasing appearance
- Are limited to similar materials

Permabond Training

Benefits of using epoxies:

Single Part Epoxies

- Excellent structural strength
- Simple to Use
- One Part - No Mixing Required
- Very High Performance
- Excellent Temperature & Chemical Resistance
- No Pot Life Limitation

Two Part Epoxies

- Excellent structural strength
- Extremely Versatile
- Cure Speed
- Gap Fill
- Temperature & Chemical Resistance
- Bond a Wide Variety of Surfaces
- Good Impact Resistance

Epoxy - Product Selection

Products are selected based on strength, process and environmental resistance requirements. Below is a sampling of Permabond epoxies:

- **5 Minute Epoxy** – Fast & non-yellowing (i.e. ET500)
- **High Strength & Free Flowing** – Epoxy flows like solder when heated during curing. The adhesive is toughened for maximum impact resistance, along with excellent peel and shear strength (i.e. ES558).
- **High Strength, No Sag** – Epoxy is slump-resistant (does not flow) during cure. The adhesive is toughened for maximum impact resistance, along with excellent peel and shear strength (i.e. ES550).
- **Thermally Conductive, Electrically Insulating** – Epoxy provides excellent thermal conductivity and bond strength. This epoxy was designed for application requiring heat dissipation such as bonding aluminum heat sinks to ceramic headers (i.e. ES578).
- **High Strength, Toughened** – Epoxy has excellent resistance to impact and vibration. Has high strength and excellent environmental durability (i.e. ET514).
- **Clear & Flexible** - Ideal for bonding different materials where differential thermal expansion is anticipated (i.e. ET515).
- **Thixotropic, High temperature** - Semi-flexible toughened no slump epoxy. Forms tough bonds providing high peel resistance and high shear strength coupled with excellent resistance to high temperatures. Performance can be enhanced by curing at high temperature or by being exposed to high temperature (such as during paint-stoving) (i.e. ET5401).

Permabond Training

Hands On

Proper Dispensing Demonstration

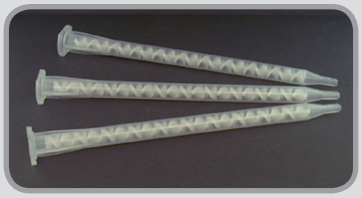
You will need:

- Sample of two part epoxy (Permabond ET514)
- Cardboard test coupon
- 50ml dispensing gun
- Static mixing nozzle

1. Remove the cartridge from the packaging and place in the dispensing gun.

2. Holding the cartridge vertical with the cap at the top, unscrew the cap or break the seal.

3. Gently squeeze the dispensing gun trigger, and make sure that both of the material components are being pushed out evenly. Wipe off any excess material, and screw on the static mixing nozzle.

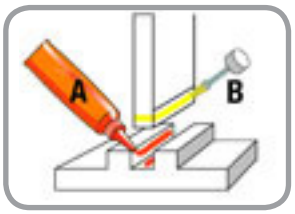


6. By squeezing the trigger, dispense the material components through the static mixing nozzle until they reach the end. It is recommended that the first 2” - 4” from a new mixer be discarded. By the use of the manufacturers’ specified mixing nozzle, the material now dispensed from the tip will be adequately and properly mixed for use.

7. It is acceptable to store partially used cartridges with the static mixing nozzle attached. A new one will be needed next time the cartridge is used. Alternatively, remove the used static mixing nozzle, wipe off excess material and replace cap, being very careful to avoid any cross contamination.

4. Structural Acrylics

What is a structural acrylic, how do they work, where are they used?



- Single-part (i.e. TA437) can be used with an activator (on non-metal surfaces or to speed cure) or without an activator (if one component is metal)
- 2-part no mix surface activated (i.e. TA459 & Initiator 43) (resin & brush-on initiator)
- 2-part no mix bead-on-bead (i.e. TA440) (Part A & Part B)
- 2-part pre-mix (i.e. TA4810) (through mixing nozzle)
- 1:1 External Mix System (i.e. TA4592)

Why bother?

Structural Adhesives provide excellent impact, shear and vibration resistance, high upper temperature limits and form durable bonds in harsh environments. These types of adhesives can support a structural load when fully cured and are ideal for bonding composites, aluminum, electric motor magnets, unprimed metals, some thermoplastics, and many other plastics.

Acrylics that are pre-mixed through the mixing nozzle are less sensitive to gap. Surface activated systems have limited gap fill. All products are low odor and non-flammable with the excpetion of methyl methacrylates.

Other Methods Include:

- Mechanical Fasteners
- Welding
- Brazing
- Other Thermal Joining Methods

Limitations of Mechanical Fasteners

- Create stress concentration points
- Are visible additions to the joint or seam
- Limited load distribution points

Limitations of Welding / Brazing / Other Thermal Joining Limitations

- Distort components
- Require secondary operations (painting, grinding) to achieve an aesthetically pleasing appearance
- Are limited to similar materials

Permabond Training

Benefits of using structural acrylics:

Bead on Bead, Surface Activated & Single Component

- Rapid room temperature cure - no ovens required
- 100% solids - Environmentally friendly
- Non stringing – Clean, efficient process
- Thixotropic viscosity –Easy to dispense
- Lower odor – Worker comfort
- Non flammable – Reduced shipping & handling costs
- High shear strength – Strong
- Toughened - Impact, vibration & peel resistance
- Durable in high moisture environments – Long component life
- High temperature (390°F) – Design flexibility

1:1 Toughened Methyl Methacrylate Adhesives

- Rapid room temperature cure - no ovens required
- 100% solids - Environmentally friendly
- Non stringing – Clean, efficient process
- Thixotropic viscosity –Easy to dispense
- High shear strength
- Toughened - impact, vibration and peel resistant
- Durable in high moisture environments
- Very good gap filling
- Excellent bond strength on plastics except polyolefins

1:1 External Mix System

- Ideal for high speed production lines
- Fast cure at room temperature
- Compatible with external mix equipment
- High shear and peel strength
- Excellent impact strength
- Good chemical resistance
- Non-corrosive formulation

Structural Acrylic - Product Selection

Products are selected based on strength, process and environmental resistance requirements. Below is a sampling of Permabond structural acrylics:

- **2 part 1:1 Methyl Methacrylate** – Thixotropic, non-sag adhesive with excellent bond strength to plastics & un-primed metal. Sets up quickly and can achieve functional strength in as little as an hour.
- **Bead-on-Bead** – Designed to mix itself upon assembly. Provides rapid bonding of metal, glass, wood and rigid plastics.
- **2-part, no-mix, Methyl Methacrylate** - Forms a very high strength structural bond with excellent environmental durability and chemical resistance.
- **Single component** - Bonds ferrites and metals for high temperature applications.
- **High impact and High temperature** - Very high strength bonding of metals, ferrites and hard plastics.
- **Acid Free & Non-corrosive** - Specifically designed to be non-corrosive to sensitive copper parts or other electrically conductive surfaces. Primarily used for bonding metals, ferrites, ceramics and some thermoplastics (i.e. TA439 or TA4590).
- **Fast cure on close fitting parts** – Provides very high strength bonding of metals, plastics, ceramics and wood.
- **1:1 External Mix System** - a high strength two component structural acrylic adhesive with excellent flexibility and outstanding impact and peel resistance. Ideal for bonding magnets and ferrites for electric motors on fast moving production lines.

Permabond Training

Hands On

You will need:

- Sample of TA4246 & Initiator 46
- Samples of TA440 A+B
- Nitrile gloves
- Metal test pieces
- Bulldog clips

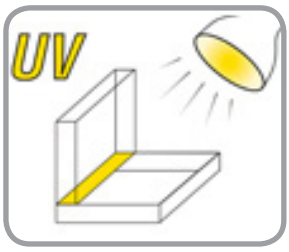
1. Brush Initiator 46 evenly onto one metal strip and dispense a bead of TA4246 onto the other metal strip. *Explain that the initiator should be applied first since it does not evaporate. The TA4246 has a monomer that evaporates off so it must not be spread and left in an open joint for a long time. Also, applying the TA4246 on top of the initiator (not on the separate test strip) is really difficult because the initiator is so slippery.*

2. On a new test strip, dispense a bead of TA440A and TA440B side by side and assemble the joint. Then make a second set, this time lay the beads on top of each other. Assemble the joint and clamp. Show that this is the correct way to apply the adhesive.

The correct way is the second, one bead on top of the other. Side by side, there is not enough mixing and only the bit where the two beads touch will actually cure.

5.UV Light Curable Adhesives

What is a UV Light Curable Adhesive, how do they work, where are they used?



- Single-part adhesives that rapidly polymerize while exposed to UV light.
- A dual cure adhesive/sealant that cures anaerobically as well as with UV light is available for specialty applications
- Permabond's plastic bonding UV curable adhesives were designed to react with both UV light and visible light. Many clear industrial plastics contain invisible UV blocking additives so the ability to cure with visible light is vital to the success of the application.

Why bother?

Permabond UV light curing adhesives are especially noted for exceptional strength and clarity required in the decorative and art glass industries. Cure speeds for glass and glass to metal bonds are completely adaptable to suit the needs of the applicaton; cure speeds in a range of 2 to 30 seconds can be easily achieved. Cure time is dependent on several parameters and can be adjusted by changing the light intensity or distance of the light from the assembly.

The wide range of viscosities available allows for both manual and automated dispensing of the adhesives.

Other Methods Include:

- Mechanical Fasteners
- Solvent Welding
- Ultrasonic Welding
- Silicones

Limitations of Mechanical Fasteners

- Create stress concentration points
- Are visible additions to the joint or seam
- Limited load distribution points
- Create appearances that can interfere with the styling of the end product
- Concentrate all the holding power at the fastener location causing the applied force to be carried by a small area of the substrate.

Permabond Training

Limitations of Solvent Welding

- Cannot be used to join plastics/rubber to other substrates such as metal or glass
- Cannot be used with thermoset plastics/rubber
- Has a tendency to cause stress cracking
- Requires pre-set and consistent time between the application of the solvent and mating of the parts

Limitations of Ultrasonic Welding

- Cannot be used on thermosets
- Cannot be used to join plastics/rubber to other substrates such as metal or glass
- Requires tighter design tolerances (small area to concentrate the ultrasonic energy is desirable)
- Limits the capability of joining different thermoplastics in the same assembly
- Requires a large investment in machinery

Limitations of Silicones

- Messy
- Extremely long cure time

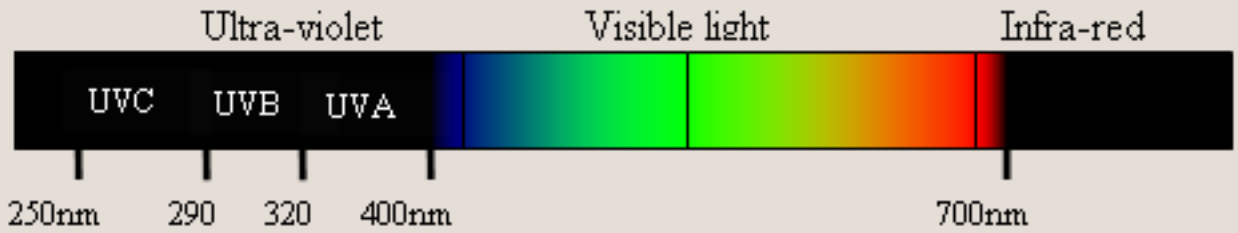
Benefits of using UV Curables:

- Cure on Demand
- Wide range of viscosities
- Dual curing capabilities
- Easier to customize adhesive and process
- Wide range of elongation - flexible products can absorb stresses
- Optically clear products available
- Excellent envitronmental durability and resistance to yellowing
- Suitable for bonding dissimilar materials
- Ideal for high speed production lines
- Cytotoxicity approved products available

Case Studies

Show the following case studies:

- ***UV620 GPS Glass Cover Bond***
- ***UV640 Washroom Equipment***
- ***UV630 & UV640 Literature Rack***
- ***UV620 Thermometer***
- ***UV625 Display Cabinet***
- ***UV649 Garden Light***
- ***UV612 Bevel Bonding***
- ***UV610 LED lighting***
- ***UV620 Door Knob***
- ***UV630 Bonnet (hood) Catches***
- ***UV620 Golf Cart switch***
- ***UV610 Fire Alarm Speaker***
- ***UV610 Glass Furniture***
- ***UV7141 Bathroom Cabinet***



Factors Affecting Cure

Light Intensity

- Distance
- Lamp focal point
- Transmission of light through the substrate.

Wavelength

- UV
- Visible

Time

- Measure the intensity at the bond site to account for these factors.

Energy

- Total UV Energy = intensity x time
- Total UV Energy = mW/cm2 x secs=mJ/cm2
- Energy is measured in joules (J) and is related to intensity (mW/cm2) and time.

6. Polyurethane

What is a Polyurethane Adhesive, how do they work, where are they used?

- Two component polyurethanes cure at room temperature
- Heat can be used to accelerate cure

Why bother?

Permabond 2-component polyurethanes have excellent toughness and flexibility. They remain flexible at low temperature. Strong bonds are formed to Metal, Glass, Plastic and Composites.

The range of products includes 1 minute potlife, 6 minute and 15 minute to support various manufacturing needs.

Other Methods Include:

- Mechanical Fasteners
- Solvent Welding
- Ultrasonic Welding
- Silicones

Limitations of other methods previously reviewed

Benefits of using Polyurethane:

- Flexible
- Bond a variety of substrates

7. Modified Epoxy

What is a Modified Epoxy Adhesive, how do they work, where are they used?

- Modified epoxies are 2 component, elastomeric epoxy technology.
- They cure at room temperature to form very flexible bonds with good shear and excellent peel strength.
- Heat can be used to accelerate cure

Why bother?

Permabond Modified epoxies come in 2:1 and 10:1 mix ratios and are prefered for panel bonding due to low shrinkage and read through. They are ideal for potting, sealing, bonding and encapsulating.
Excellent toughness, flexibility and peel strength
200% Elongation
No print through when bonding light gauge metals
Excellent adhesion to a wide variety of substrates
Good temperature resistance up to 400F for brief periods
Low temperature (-40F minimum) flexibility & impact depending on substrates
Bonds wood, concrete, metals, most plastics, composites, and FRP without a primer
UV resistant

Other Methods Include:

- Mechanical Fasteners
- Solvent Welding
- Ultrasonic Welding
- Silicones

Limitations of other methods previously reviewed

Benefits of using Modified Epoxies:

- Paintable
- Non-corrosive
- Fast Tack Free Time
- Adhesion to a Variety of Substrates
- No primer needed
- Weather Resistant - No Cracking or Splitting
- Ease of Application - Use in Most Weather Conditions

8. MS Polymer

What is an MS Polymer, how do they work, where are they used?

■ MS Polymers are a hybrid technology, single part, room temperature moisture cure product that provide high elongation.

Why bother?

Permabonds single component MS Polymers provide:

Excellent toughness and flexibility
Excellent peel strength
200% Elongation
No print through when bonding light gauge metals
Excellent adhesion to a wide variety of substrates
Good temperature resistance up to 400F for brief periods
Low temperature (-40F minimum) flexibility & impact depending on substrates
Durable bonds to wood, concrete, metals, most plastics, composites, and FRP without a primer
UV resistance

Other Methods Include:

- Mechanical Fasteners
- Solvent Welding
- Ultrasonic Welding
- Silicones

Limitations of other methods previously reviewed

Benefits of

- Paintable
- Non-corrosive
- Fast Tack Free Time
- Adhesion to a Variety of Substrates
- No primer needed
- Weather Resistant - No Cracking or Splitting
- Ease of Application - Use in Most Weather Conditions